THE

AMERICAN NATURALIST.

Vol. 1.—APRIL, 1867.—No. 2.

THE MOSS-ANIMALS, OR FRESH WATER POLYZOA.

PLATE 3.

BY ALPHEUS HYATT.

Among all the creatures found in our pools and lakes, none are more pleasing to the eye when carefully examined, than the Moss-Animals. These delicate animal-flowers may be found in communities, expanding their shadowy plumes in the darker recesses of our ponds, attached to the under side of submerged sticks, logs and stones.

Figures 1, 2, and 3, in the plate, show three of these communities. In figures 2 and 3 the plumes are expanded, but in figure 1 they are withdrawn, as they always are when the colony is disturbed.

The moss-animals of our fresh waters are, with two exceptions, all members of one group, called Phylactolæmata, or animals with guarded throats; that is, having a little flap outside of the mouth, which guards this aperture. The two exceptions mentioned have not this characteristic, and, therefore, belong to the same division

as their marine relatives, the Gymnolæmata, or Polyzoa with unguarded throats. Notwithstanding their harsh scientific name, the Phylactolæmata are light, elegant, mossy growths, and, when placed under a low power of the microscope, are even more beautiful than the flowers they resemble.

Their plant-like aspect, however, is a mere semblance, notwithstanding the branching mode of growth. If we examine any one specimen of the genus Fredericella, we speedily learn that the trunk is not a single, straight, solid stem, as in the plants, but made up of a series of minute, dark brown, tubular cells, arranged in a line, with the main branches and shorter twigs, also constructed of cells, arranged in a similar manner. Each cell (fig. 4) is a single animal, and contains the organs and muscles of one being, though so intimately attached to others, and so merged in the general life of the community, that it cannot, strictly speaking, be called an individual. An individual is but one animal, freely following the bent of its own will, and containing within itself an isolated, independent system of organs.

The lower portion of every cell is straight, being the continuation of the axis of the trunk, or branch of which it is a part; but the upper portion turns out of the direct line with an elbow-like bend, elevating one end above the stem. This end is free, and is surmounted by a transparent tube, which is closed by a round disc, perforated by the mouth, and bearing a crown of translucent, slender threads, called tentacles, which gracefully curve upwards like the petals of a lily (fig. 4, II). The tongue-like flap overhangs the mouth, and is continually jerked downward, instantly resuming its upright position, as if it were hinged on springs (fig. 5, I′). This is a most curious organ, and

although situated outside of the mouth (fig. 5, I''), it seems to answer many of the ordinary purposes of a tongue. It evidently discriminates between the different kinds of food, but is oftener employed to close the mouth over some struggling animalcule which obstinately refuses to be swallowed. It is a fleshy semicircular prominence formed by a fold of the disc (fig. 5, I), and is both the door of a trap, and an organ of taste combined.

The crown is interesting, not only on account of its beauty, and delicate transparency, but from the dreamy outline of each little thread, caused by the movements of the innumerable hairs investing them. The hairs, or cilia, themselves, are not visible, owing to their extreme tenuity, but the waves they make in the water can be plainly seen. So many thousands of these cilia are simultaneously moving upward on the outer sides of the threads, and downward upon their inner sides, that they force the water along in strong currents from the exterior down toward the bottom of the open-work vase where the mouth lies. The meeting of these currents coming from all sides at once, creates a whirlpool, in which hundreds of careless animalcules are continually caught and transported to the mouth. This being placed at the centre of the vortex catches all the objects entrapped by the current above, and it has, also, unfortunately for its helpless prey, a stomach beneath, which is indeed "an abyss no riches can fill." The thousands of sleepless cilia are day and night constantly in motion, drawing into the throat an endless stream of food. The stomach below is equally active, and thus all the organs work harmoniously, like machinery driven by steam, untiringly capturing and digesting the food, which, when assimilated, supplies the waste occasioned by the great activity of these parts. The threads

or tentacles, also prove useful in many other ways. They can twist together with incalculable rapidity, barring out any objectionable animal which may manifest a disposition to pry into the crown; or each one can by itself bend over and eject annoying particles; or, if the throat need a little cleaning, force its way down the tube and clear it, by pushing into the stomach whatever may be clinging to the sides. They are most amusing, however, in the angry pettishness they occasionally exhibit toward intruding neighbors. First comes an admonitory push, then a harder one, if the first is not successful, and lastly, unmistakeable blows administered with vicious rapidity by many threads in unison. Sometimes a "big fish" enters the crown in the shape of an animated speck, perceptible only when magnified twenty or thirty times its own size; then the sensitive tips of the threads curve together, and imprison the coveted morsel. Caged thus in a living net, and unable to break through the bars, it is soon exhausted by the power of the miniature maelstrom, and swept, in spite of many fruitless struggles, down into the gaping mouth.

On the exterior of the tentacles, reaching about half-way up their sides, is a thin veil, looped up and hanging gracefully between them like a delicate ruffle with pointed folds (fig. 4, G). Between this veil and the dark brown cell is the pellucid tube, and through its walls we can examine the internal organs. Directly under the tongue-like projection of the disc, or epistome, is the nervous mass, which takes the place of a brain in all the Polyzoa, (fig. 5, S). It has nerves leading to the throat, the stomach and intestine, besides two branches that go to the disc, and distribute those minute nervous tendrils, which endow them with such acute sensibility. The epistome,

or false tongue above the mouth, being only a fold of the disc, is hollow. The nerve-mass retreats into this cavity at will, probably by means of minute muscular fibres; and in this position, also, seeks security from injurious pressure, while the polyzoön is crowded within the shelter of its cell. Thus the epistome, in addition to its other multifarious uses, serves at times as a brain box.

The organs of digestion hang from the disc above, occupying the centre of the tube, and floating freely in the rapidly moving blood (fig. 5, K, K′, K″). The throat is closed at the lower end by a valve (fig. 5, K″), which opens into a gourd-shaped sack, the stomach; close by this is another valve which opens from the stomach into the intestine (fig. 5, K″″). The last is a canal leading up, side by side with the throat, for a short distance, but finally bending away from it, and opening externally through an aperture in the pellucid tube, just below the base of the ruffle, and not far from the mouth (fig. 5, $\overline{\text{K}}$).

Though the walls of these organs are variously tinted, they are not opaque, and, therefore, while not interfering materially with the view through the clearer substance of the tube, add greatly to its beauty. The yellowish throat, the stomach striped with dark brown, and the intestine, also dark brown, form a colored axis, giving a lifelike warmth to the airy delicacy of the surrounding film.

We have seen by what strange methods the food is captured, but this is not more curious than the way in which it is digested. A throatful, for we cannot say mouthful, is no sooner admitted to the stomach, than it is rolled up and down from one end to the other, with great violence. The walls of this organ take on a circular constriction, which pursues the morsel without intermis-

sion, forcing it first to one end, and then back again to the other, from which it entered, until the particles are all crushed and reduced to a pulp. These violent convulsions also serve another purpose; they squeeze the nutritious matter, resulting from digestion, out through the membranes of the stomach into the cavity of the tube and cell, where it becomes mingled with the blood, and is carried off to give health and strength to the body.

We have spoken of the plumes being withdrawn, in one of the colonies figured, and, though it has been only casually mentioned, this habit is the greatest obstacle to the observer while endeavoring to study their form. If the table be shaken ever so lightly, every unfolded crown vanishes, and often half an hour or more elapses before continued quiet allures them forth.

All the finely proportioned, transparent parts are balanced upon a fold of the wall of the tube (fig. 5, B), which is retained in its place inside of the cell by many muscles, like fine hairs, attached by one end to the fold, and by the other to the cell wall (fig. 4, N, N′, fig. 5, N). A continuation of the fold-membrane carpets the whole interior of the cell (fig. 4, 5, E), and to it are attached, near the lower end, the muscular fibres which drag the crown and the more delicate external parts into its shelter, at the approach of danger (fig. 4, M). The muscles are arranged in great broad bands rising in two trunks, each one spreading out above into numerous smaller branches. These branches are attached to the stomach, throat and disc near the mouth, and one of them to the wall of the tube not far from the base of the veil (fig. 4, M, M′, M″). They are diaphanous, but their delicate aspect is no measure of their strength. They jerk the crown and outer tube within the cell quicker than the eye

can follow them; and it is a curious fact, that after the movement is completed, and they are safely ensconced, the fibres are not content to rest, but still keep up a lively motion, writhing and twisting like bundles of minute worms.

The tentacles all the while lie gathered closely together in the sheath, formed for them by the tube, which has been doubled upon itself inside of the cell, like the finger of a glove inverted within the empty palm. When once more ready to emerge, the opening of the cell, which has been contracted by a circular band of muscle, like the mouth of a bag drawn up with a string, relaxes and permits the ends of the tentacles to protrude. These warily search for the cause of the previous alarm, and, if no hostile movements betray the presence of an enemy, the whole bundle slowly and cautiously follows, halts a moment, and then confidently unfolds its circlet of sentient threads. The Polyzoön reasons from the impression made upon these feelers, and cannot be induced to expose itself until thoroughly satisfied, by their exquisite sense of touch, that no danger lurks near its retreat.

Strange to say these plant-like creatures, singly mere animated pouches containing stomachs, show greater nervous sensibility than many more highly organized animals. They continually surprise us by actions which exhibit caution, fear, and anger to a remarkable extent, and imply a degree of complication in their relations, both social and physical, which the simplicity of the organization, and the limited sphere of its exercise render doubly interesting to the philosophical observer.

The wonders revealed in the structure of these lovely dwellers in the perennial shadows of our fresh waters, tempt one to linger, but the history of their circulatory

and respiratory functions, and their curious modes of reproduction must be deferred until the next number.

EXPLANATION OF PLATE 3. *Fredericella regina* Leidy.

Fig. 1, 2, and 3. Colonies attached to pieces of bark.

Fig. 4. Magnified view of one Polyzoön. D, brown envelope, the ectocyst; E, pellucid wall of the tube and cell, the endocyst; V, funiculus; M, M′, M″, upper branches of the muscles, the retractors; N, N′, muscles of the fold, the retentors; F, a small infolding of the endocyst, the brachial collar; G, the pointed ruffle, or calyx; H, the threads, or tentacles.

Fig. 5. Outline of the interior of part of a young specimen. Same letters as above, with the exception of B, the invaginated fold of the tube; Y, a very young polyzoön, a bud; K, the throat or œsophagus; H″, cilia surrounding the mouth; K‴, the valve opening into the stomach, œsophageal valve; K′, stomach; K⁗, intestinal valve partly open; K″, intestine; $\overline{K}$, opening of intestine, the anus; I, disc, the lophophore; I′, the little flap, the epistome; I″, the mouth; S, nerve-mass.

Fig. 6. Side view of the top of a cell, with the tube and crown drawn within; letters same as before with the exception of A⁗, contracted orifice of the cell; L, position of muscular band, the sphincter.

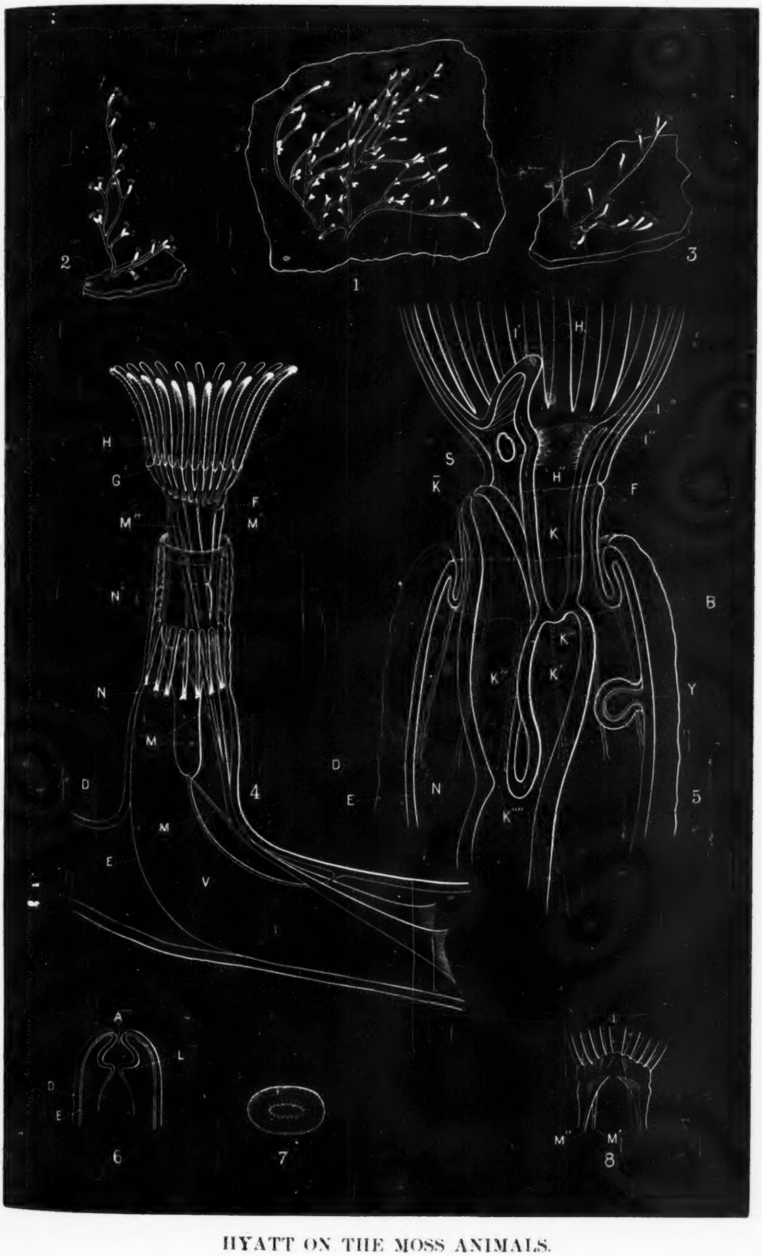
Fig. 7. View of the same from above.

Fig. 8. Front view, showing upper branches of the retractors, which are attached to the wall of the tube and to the disc, M″ and M′.

THE FERTILIZATION OF FLOWERING PLANTS.

BY J. T. ROTHROCK.

It is now universally accepted by botanists that there exist distinct sexes in the vegetable kingdom, and that nature's method of maintaining the existence of a specific form, is to bring the male and female elements in contact. In a normal flower, the first group of organs we find inside the corolla, are the stamens; while the yellow powder, so frequently found inside of the swollen ends (anthers), is the pollen or male element. In the centre



HYATT ON THE MOSS ANIMALS.

of the flower we usually find one or more organs, called the pistil or pistils. The end or edge of this organ is called the stigma, which is generally more or less viscid. It is upon this viscid stigma that the pollen falls, or is conveyed by insects, the wind, or other agents. Soon a small tubule shoots out from the pollen grain; this tubule grows down through the stigma and style, into the ovary, where it comes in contact with the unfertilized ovule, which is then fertilized, and becomes capable of developing in its cavity an embryo that in time, and under favorable conditions, will become a perfect plant. In by far the greater number of flowering plants, we find both the male and female element in the same flower, or, in other words, such plants are hermaphrodites. One would naturally suppose that there could be but one object in thus placing the sexual elements in such immediate juxtaposition, namely, that each pistil might be fertilized by its own pollen or male element. Late researches have, however, made it evident that often even among plants, the nuptials cannot be celebrated without the intervention of a third party to act as a marriage priest, and that the office of this third person is to unite the representatives of different households. To be specific, seed capsules are most productive when their ovules are fertilized by pollen from another plant, or flower of the same plant. "Breeding in and in," can by absolute experiment, be proven to produce a degenerate offspring in the vegetable kingdom, no less than in the event of a marriage between first cousins in the human race.

Now the marriage priests who officiate in the vegetable kingdom are insects in search of honey; the winds, or anything which by accident, or design, may carry the pollen from one flower to another. How often do we

hear our agricultural friends complain, that they cannot succeed in keeping pure some choice varieties of vegetables, in consequence of the pollen from some common stock being wafted or carried to the pure variety, and thus contaminating it? Mr. Darwin has lately proven in the case of the genus *Linum*, or Flax, that though the stigma of a flower be completely dusted over with its own pollen, not one seed will be matured. This certainly was a "capital experiment." Though the impotency of pollen when applied to its own stigma is absolute in this case, we may not infer the line is always so sharply drawn. Facts contradict this; but a great step will have been taken in the right direction if we are taught to question many so-called instances of close fertilization. For example, most of us are familiar with the general habit of our common Laurel (*Kalmia*). We remember, also, that when in bloom, it shows us a waving sea of beautiful, rose-colored flowers, growing so closely together as to almost hide the leaves from view. When the flower first opens, we may observe that there is one small pocket in each angle of the flower, and that toward each of these pockets is bent backwards a stamen, so that an anther is included in each pocket. Every stamen represents a spring just ready to fly to a natural position of rest, when let loose. An insect in search of nectar lights on the flower, and in so doing jars the flower sufficiently to cause the stamen to spring up and converge over the stigma. Here, at once we say, the design is close fertilization. But not so fast. Pollen is often carried by the force of the spring to the pistil of an adjacent flower; and remembering the lesson taught us by the flax, we are not sure that pollen of one flower may not be prepotent when applied to the stigma of another flower, and so completely destroy close fertilization. We

do not say it *is* prepotent; any reader of the "Naturalist" may experiment for himself on the Kalmia. It is only offered here as a hint.

The field opened up by Mr. Darwin's experiments is new, and alluring, and perchance for that very reason may sometimes be so attractive as to lead us beyond the limits of sound reasoning, and reliable experiments. Yet there exists a group of plants in the study of which we may almost feel safe in giving a loose rein to our theories, for facts already ascertained, prepare us to believe nothing can be too strange to be true, in relation to the fertilization of this group. I allude to the so-called *dimorphic* plants; where the same species presents two distinct forms, one with long stamens and short pistils; the other with short stamens and long pistils. Now it has been proven in the case of the Flax, and of the Primrose, that the most fertile union is that which results from the impregnation of the long-styled forms by the pollen of the short-styled, and the reverse. Some experiments made by myself, at the suggestion of Prof. Asa Gray, convince me that the same applies in a remarkable degree to our common little Spring Beauty (*Oldenlandia*), or, as it is commonly called, Innocence or Bluets.*

This differentiation of the specific form, may even go farther, and give us trimorphic plants. I cannot better illustrate what I mean, than by quoting at length, though at second hand, from Mr. Darwin's paper, "On the Sexual Relations of the three forms of Lythrum salicaria."

*In Oldenlandia we find an evident structural differentiation of both pollen and stigma. The relative length of the stamens of one form when compared with that of the style of the other form, almost drives one to the conclusion that the design, in this case, is to secure cross-fertilization. I have frequently observed a species of Thrips crawling about from flower to flower, with its back completely dusted over with pollen.

"In Lythrum salicaria (Spiked Loosestrife) three plainly distinct forms occur; each of these is an hermaphrodite; each is distinct in its female organs from the other two forms; and each is furnished with two sets of stamens or males, differing from each other as much as if they belonged to different species; and if smaller functional differences are considered, there are five distinct sets of males. Two of the three hermaphrodites must co-exist, and the pollen be carried by insects reciprocally from one to the other, in order that either of the two should be fully fertile; but, unless all three forms co-exist, there will be a waste of two sets of stamens, and the organization of the species as a whole will be imperfect. On the other hand, when all three hermaphrodites co-exist, and the pollen is carried from the one to the other, the scheme is perfect; there is no waste of pollen and no false co-adaptation. In short, nature has ordained a most complex marriage arrangement, namely, a triple union between three hermaphrodites, each hermaphrodite being in its female organ quite distinct from the other two hermaphrodites, and partially distinct in its male organs, and each is furnished with two sets of males."

It farther appears, "that only the longest stamens fully fertilize the longest pistils, the middle stamens the middle pistil, and the shortest stamens the shortest pistil. And now we can comprehend the meaning of the almost exact correspondence in length between the pistil of each form, and the two half dozen sets of stamens borne by the two other forms; for the stigma of each form is thus rubbed against that spot of the insect's body, which becomes most charged with the proper pollen."

Mr. Scott has led us to adopt a new clause in our scientific creed, and one, which, did it not come properly

vouched for, might well cause a rising doubt. He tells us that the pollen of one species of Passion Flower will fertilize the ovules of another species, though the ovules of the first may not in turn be fertilized by the pollen of the second. Thus Tacsonia mollissima will fertilize the ovules of Passiflora racemosa, but Passiflora will not fertilize Tacsonia.

Interesting as may be the means resorted to in the cases above mentioned, to secure cross-fertilization (mostly through the medium of insects) they yield in fascination to the adaptations by which the same results are accomplished by the same agents in many Orchids.

We must refer those who wish to go into the details of fertilization, as it is brought about in this gorgeous family, to Mr. Darwin's interesting volume on "Fertilization of Orchids by Insects." They will there find the subject treated of by a master mind in such inquiries. The temptation to meddle in work so much better done elsewhere, is too great, and we should be surprised at ourselves if we passed the subject entirely by. Among the Orchids and Milkweeds (*Asclepias*), we find that the pollen, in place of being loose, or at the most slightly coherent, is here neatly done up in two small decanter-shaped packets, which are connected at the top of the necks by a small, viscid gland.

Let us imagine that on some bright summer morning, a humble bee, for example, happening to be out in search of the material from which to get its store of honey, alights on one of these Orchids. Standing, perchance, on the large lip (so prominent among these flowers), it dips its head down to the bottom of the flower in search of nectar. The chances are ten to one that its forehead strikes directly upon this viscid gland connecting the two

packets of pollen. By the time the nectar is exhausted the gland has become adherent to the bee's head, and as it (the head) is withdrawn, the two pollen masses are extracted from their pockets, and now stand off in front like a pair of horns. The bee, most likely, flies to another plant of the same species, or still more probably to another flower of the same plant. Suppose the stigmatic surface of this species of plant be broad, or possibly separated almost into two parts; we will find the packets have slowly but surely diverged so as to be the exact width of that surface. Suppose on the other hand, the stigma be a narrow one, we shall find that the packets have come close together. In either case when the bee's head bobs down into the next flower, it will almost certainly happen that these same pollen masses will be left sticking on the stigma when the bee leaves, or at least part of the pollen will be left. These masses of pollen have long since been frequently observed on the bee's head, but, until quite lately, no meaning had been attached to it. Some entomologists, I believe, have even been guilty of describing these as natural appendages to the bee's head. So manifest are these adaptations for the purpose of cross fertilization among Orchids, that we may be well nigh sure some great purpose is to be subserved. Perhaps it would not be too much to say, that but for insect agency many Orchids would become extinct. There are not wanting those who even affirm the insect shape assumed by some Orchidaceous flowers, has no less purpose than to serve as a decoy, and thus tempt the bee or butterfly to alight upon them and accomplish the work of fertilization. Those wishing to be apprized of the mode of fertilization, as it occurs in our American plants, will find some admirable articles from the pen of Prof. Asa Gray, in Silliman's Journal

for 1862. Robert Brown long since called attention to insect agency, in the fertilization of the Milkweed family. Almost any summer day we may repeat his observations for ourselves. So adhesive are the glands of the Asclepias obtusifolia (Wavey-leaved Milkweed), that we often find honey bees unable either to withdraw the packets, or loose their feet from the gland, and thus they become prisoners for life.

There exists yet another class of dimorphic flowers, in which we find the large and more conspicuous flowers less fertile than those of the other form, which are arrested in their development, and are fertilized in the bud. Hugo van Mohl has of late called especial attention to them. Such flowers have been happily termed precociously fertilized. Mohl concludes, after close examination of Viola, Oxalis, Specularia and Impatiens, that nature is here specially solicitous to secure close breeding, or that each flower shall be fertilized by its own pollen. He calls attention also to the fact, that in the large anthers of the smaller form of Oxalis acetosella, not more than two dozen pollen grains are found, while in the anthers of the larger form they are much more numerous. In the smaller form, however, the few grains are made more potent, and the exercise of their function is secured, by being placed in contact with the stigma. It results, however, that our list of closely fertilized plants is becoming smaller, under the repeated observations of accurate investigators, and that, what was supposed to be a special adaptation to secure close fertilization, is, after all, but a more nicely conceived method of obtaining an opposite result. For example, we were formerly taught that the interior petals of Corydalis clasped the anthers and stigma of the flower in so tight an embrace that outside fertilization

was a thing not to be thought of. Dr. Hildebrand informs us however, that though the stigma of Corydalis cava be completely dusted over with pollen from the same flower, yet no seed will set if insects be excluded from carrying pollen from flower to flower. This fact is, as will be observed, another illustration of Mr. Darwin's law of prepotency of pollen taken from one flower, and applied to another. Professor Gray also calls attention to the "effectual activity of so large an insect as the bumble-bee in fertilizing our Corydalis aurea" (Golden Corydalis).

Just now we can point to but one instance in which a plant of high order is found to produce perfect embryos, without the ovules having been previously fertilized according to the known method. In the Kew Gardens, near London, has been kept for many years a plant of the Spurge family, which furnishes this one example. Dr. Hooker writes to Humboldt concerning it, as follows: "Our Cœlebogyne still flowers with my father at Kew, as well as in the Garden of the Horticultural Society. It ripens its seeds regularly. I have repeatedly examined it with care, but have never been able to discover a penetration of pollen utricles into the stigma, nor any traces of their presence in the latter or in the style." This plant belongs to the old Linnæan class Diœcia. It is unisexual, and as there exists only (so far as known) the female plant in England, it is difficult to conceive how the fertilization is accomplished, unless through the agency of concealed anthers. Though diligent search has been made time and again for the anthers, they do not seem to have been found. We may still fairly hesitate before accepting this as an example of parthenogenesis, or virgin fertility.

INSECTS AND THEIR ALLIES.

BY A. S. PACKARD, JR., M. D.

That branch of the Animal Kingdom known as the ARTICULATA, is so called from having the body composed of rings or segments, like short cylinders, which are placed successively one behind the other. Cuvier selected this term because he saw that the plan of their entire organization, the essential features which separate them from all other animals, lay in the idea of articulation, the apparent joining together of distinct segments along the line of the body. If we observe carefully the body of the Worm, we shall see that it consists of a long cylindrical sac, which at regular intervals is folded in upon itself, thus giving a ringed, annulated or articulated appearance to the body. In the Crustacea (Crabs, Lobsters, etc.) and in the Insects, from the deposition of an earthy salt, called *chitine*, the walls of the body become so hardened, that when the animal is dead and dry, it readily breaks into numerous very perfect rings.

Fig. 1.

Worm-like larva of a Fly, *Thereva?*

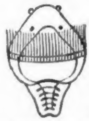
Though this branch contains a far greater number of species than any other of the animal kingdom, their myriad forms can all be reduced to a simple, ideal, typical figure; that of a long slender cylinder divided into numerous segments, as in Fig. 1, representing the larva of a Fly. It is by the unequal development and the various modes of grouping them, as well as the differences in the number of the rings themselves, and also in the changes of form of their appendages, i. e., the feet, jaws, antennæ and wings, that the various forms of Articulates are produced.

In all Articulates the long, tubular, alimentary canal occupies the centre of the body; above it lies the "heart,"

or dorsal vessel, and below, upon the under side, rests the nervous system. The breathing apparatus, or "lungs," in Worms consists of simple filaments, placed on the front of the head; or of gill-like processes, as in the Crustacea, which form simple expansions of the legs; or, as in the Insects, of delicate tubes (*tracheæ*), which ramify throughout the whole interior of the animal, and connect with breathing pores (*stigmata*) in the sides of the body. They do not breathe through the mouth as do the higher animals. The tracheæ and blood-vessels follow closely the same course, so that the aëration of the blood goes on, apparently, over the whole interior of the body, not being confined to a single region, as in the lungs of the vertebrate animals.

Thus it is by observing the general form of the body-walls, and the situation of the different anatomical systems, both in relation to themselves and the walls of the body, or crust, which surrounds and protects the more delicate organs within, that we are able to find satisfactory characters for isolating, in our definitions, the articulates from all other animals.

Fig. 2.



Young Terebella, soon after leaving the egg. A. AGASSIZ.

We shall perceive more clearly the differences between the three classes of articulates, or jointed animals, by examining their young stages, from the time of their exclusion from the egg, until they pass into mature life. A more careful study of this period than we are able to enter upon at present, would show us how much alike the young of all articulates are at first, and how soon they begin to differ, and assume the shape of their class.

Most Worms, after leaving the egg, are at first like some infusoria, being little sac-like animalcules, often ciliated over nearly the entire surface of the infinitesimal

body. Soon this sac-like body grows longer, and contracts at intervals; the intervening parts become unequally enlarged, some segments or rings, formed by the contraction of the body-walls, greatly exceeding in size those next to them; and it thus assumes the appearance of a being, more or less equally ringed, such as in the young Terebella, here figured, where the ciliæ are restricted to a single ring surrounding the body. Gradually the ciliæ disappear and regular locomotive organs, consisting of minute paddles, grow out from the side; feelers (antennæ), jaws, and eyes (simple rudimentary eyes) appear on the few front rings of the body, which are grouped by themselves into a sort of head, though it is difficult in a large proportion of the lower worms, for unskilled observers to distinguish the head from the tail. In the embryo of the Crustacean, such as the Fresh-water Crawfish, as shown by the German naturalist Rathke; and also in the earliest stages of the Insect, the body *at once* assumes a worm-like form, thus beginning its embryonic life from the goal reached by the adult worm.

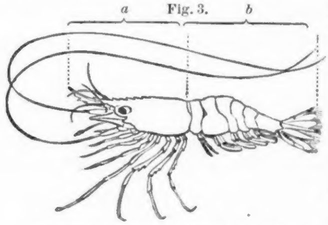
Thus we see throughout the growth of the worm, no attempt at subdividing the body into regions, each endowed with its peculiar functions; but only a more perfect system of rings, each relatively very equally developed, but all becoming respectively more complicated. For example, in the fresh-water Nais, each ring is plainly distinguished into an upper and under side, and in addition to these a well marked side-area, to which, as in the marine worm, *Nereis*, oar and paddle-like organs are attached; in most other worms eye-spots appear on the front rings, and slender tentacles grow out, and a pair of nerve-knots (*ganglia*) are apportioned to each ring.

Thus, in the Worm the vital force is very equally distrib-

uted to each zoölogical element, or ring of the body; no single part of the body is much honored above the rest, so as to subordinate and hold the other parts in subservience to its peculiar and higher ends in the animal economy.

But when we rise in the scale of articulate life, we see at once the action of a new principle. First in the Crustacean appears a broad distinction between the front and posterior end of the body. The rings are now grouped into two regions, and the hinder division is subordinate in its structure and uses to the forward portion of the body. Hence the nervous power is transferred in some degree towards the head. The organs performing the functions that distinguish animals from plants, such as locomotion and sensation, all reside in the front region; while the vegetative functions, or those concerned in the reproduction and nourishment of the animal produced, are mostly carried on in the hinder region of the body (the abdomen).

Fig. 3.



Pandalus annulicornis Leach. A Shrimp. *a*. cephalothorax; *b*. abdomen.

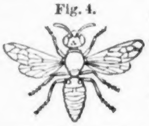
The Crustacean cannot be said to have a true head, in distinction from a thorax bearing the organs of locomotion, but rather a group of rings, to which are appended the organs of sensation and locomotion.

Sometimes the jaws become remarkably like claws; or the legs resemble jaws at the base, but towards their tips become claw-like; gill-like bodies are sometimes attached to the foot-jaws, and thus, as stated by Prof. J. D. Dana, in the introduction to his great work on the Crustacea of the United States Exploring Expedition, the typical Crus-

tacea do not have a distinct head, but rather a "head-thorax" (*cephalo-thorax*).

When we rise a third and last step into the world of Insect forms, we see a completion and final development of the articulate plan which has been but obscurely hinted at in the two lowest classes, the Worms and Crustacea. Here we first meet with a true head, separate in its structure and functions from the thorax, which, in its turn, is clearly distinguishable from the third region of the body, the abdomen, or hind-body. These three regions, as seen in the wasp, are each provided with three distinct sets of organs, each having distinct functions, though all are governed by, and minister to the brain force, now in a great measure gathered up from the posterior rings of the body, and in a more concentrated form (the brain), lodged in the head.

Fig. 4.



Philanthus ventilabris Fabr. A Wood-wasp. From SAY.

Here, then, is a centralization of parts headwards; they are brought as if towards a focus, and that focus the head, which is the meaning of the term "cephalization," proposed by Professor Dana.* *Ring* distinctions have given away to *regional* distinctions. The former characterize the Worm, the latter, the Insect. In other words, the division of the body into three parts, or regions, is in the insect, on the whole, better marked than the division of any one of those parts, except the abdomen, into rings. This is

*In two papers on the Classification of Animals, published in the *American Journal of Science and Arts*, Second Series, vol. xxxv, p. 65, vol. xxxvi, July 1863, and also in his earlier paper on Crustaceans, "the principle of cephalization is shown to be exhibited among animals in the following ways:—

1. By a transfer of members from the *locomotive* to the *cephalic* series.
2. By the anterior of the locomotive organs participating to some extent in cephalic functions.
3. By increased abbreviation, concentration, compactness, and perfection of structure, in the parts and organs of the anterior portion of the body.
4. By increased abbreviation, condensation, and perfection of structure in the posterior, or gastric and caudal portion of the body.
5. By an upward rise in the cephalic end of the nervous system. This rise reaches its extreme limit in Man."

well illustrated in the thorax of the Wasp. In reality the thorax of this insect consists of three rings, with a supernumary one—the first and basal ring of the abdomen—thus forming a compact mass, consisting of four of these rings. But all are so intimately united into an almost spherical, rounded mass, which is due to the unequal size of the parts composing the rings, some being enlarged, and others either diminished in size, or wholly wanting, that it needs the sagacity of a Latreille, or an Audouin, those fathers of Entomology, to detect the actual number of the elemental rings.

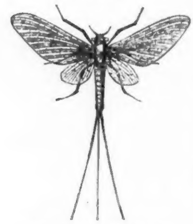
Appended to the head, as the legs to the thorax, are special organs of sight and touch, into which the brain is immediately projected; as the simple and compound eyes, and the antennæ, each with their separate pair of nerves. These are placed in front of the mouth. Behind the mouth, and on each side, are the jaws or mandibles, the maxillæ with their palpi (or touchers), and last of all, and next to the thorax, the labium, or under lip, and its palpi. Before the larva leaves the egg, these four pair of appendages are much alike in form, budding out as simple tubercles, and their relative position and succession are as given above; but during growth they change their position, crowd forward about the mouth-opening, so as to lose nearly all traces of their normal succession, and, in consequence, the labial palpi seem to be more properly placed in advance of the maxillæ, while the mandibles appear, on their part, to be inserted at the base of the head next to the thorax; and it is only by tracing their origin and development, as given in the works of Claparède and Weismann, which we shall farther notice in this journal, that we have been able to understand their normal position.

Insects, as a whole, are much smaller than the Crustacea; for example, compare a Honey bee or Hawk moth with a Lobster or Crab. This diminution of size is due to the greater concentration of parts, and their compression into a much less bulk. Crustacea are mostly inhabitants of the water, while Insects are, in some form, almost exclusively terrestrial. As the Whale exceeds in size the Dog or Lion, or Man himself, so does the Lobster surpass in bulk the Bee, though the latter is a much more highly organized animal, with a more complicated outer crust, a more complex system of nerves, bloodvessels and muscles.

There are various grades of superiority among insects. Rank among men is determined by one's superior intelligence, and less and less likeness to the savage. Thus writers on Ethnology place the European and Australasian at two extremes. On this principle the zoölogist classifies animals by their greater or less resemblance to the lowest types. Thus among Articulates, the Worms are the simplest in form, and in all respects the lowest. The Crustacea are placed next in the natural system, which leaves the Insects topping the series. In classifying the subdivisions of the class of Insects, we observe the same principle. In locating an Insect in what seems to us its true place within its own group, we must follow this rule, i.e., its greater or less resemblance to the typical wormlike form, for the more the body is developed *headwards* the higher is its rank. Among the lowest Insects are the May-flies (*Ephemera*), the Panorpa, or Forceps-tail, and the Spring-tails (*Podura* and *Lepisma*). In these forms the body is slender and wormlike, and the head is many times smaller than the rest of the body. In the Honey bee however, which is the highest among all articulates, the head is but little smaller, and yet very distinct from

the thorax; which again, is but a little smaller than the abdomen. In the Bee, more than in other insects, the rings, or parts of rings remaining after the growth of the animal has been completed, are more equally developed than in the lower insects—no single part attains a monstrous development over the other, as in the May-fly or Dragon-fly. The Bee, of all insects, performs the most varied and complex intellectual acts; in its immense colonies—a rude foreshadowing of human republics—are portioned out to the Queen, the Worker and the Drone, special duties in the insect economy. How varied those duties are, how readily a Worker will perform some acts rarely or never before attempted, and how ready these insects, and their allies, the Ants, are to adapt themselves to new and untried circumstances, all Bee keepers and entomologists are well aware.

Fig. 5.



Ephemera, May Fly.

Let us for a moment look more closely at the tough parchment-like crust of the Insect. We shall then better understand what has been said of its complexity. We find that each ring when examined by itself, consists of an upper (*tergite*), and under (*sternite*), and side-pieces (*pleurite*, consisting of the *epimerum* and *episternum*). These sections of a circle rest on each other, giving the greatest strength and resistance to the whole ring. In the perfect insect the simplest form of the elemental ring is found in the abdomen. The upper and lower arcs are nearly equal in size, and the side-piece is also well mark-

Fig. 6.*

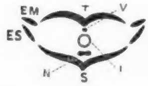


*Fig. 6. Section of an abdominal segment of an hemipter, *Ranatra*. T. tergum; S. sternum; EM. epimerum; ES. episternum; N. nervous system; I. alimentary canal; V. dorsal vessel. L. DUTHIERS.

ed, as seen in the body of the caterpillar. When, however we turn to a thoracic segment, the relative size of the pieces is very unequal, the side-pieces being much larger than the upper or under piece, especially in the Dragon-fly, which is ever on the wing. In the Libellula, the upper part of the ring is greatly reduced in size, and the larger part of the ring consists of the side-pieces. As a rule, however, the under piece (*sternum*) is very small, the dorsal or upper-piece (*tergum*) is well developed, while the side-pieces are increased in a still greater ratio, as seen in the Wasp, which walks and also flies with ease. The side, or limb-bearing part of the ring, is generally largest in the running insects, as in the Beetles, of which *Carabus*, the Ground-beetle, is a type. On the other hand the dorsal (or *tergal* piece, the more technical name, since the word dorsal is more appropriate in speaking of the vertebrates, or animals with a back bone) part of the ring is quite small in the Dragon-fly and its allies. In these insects, which scarcely ever walk, merely using their legs in clinging to plants when resting from their long sustained flights, the side-pieces are disproportionately enlarged over the other parts of the ring, for the purpose of affording broad attachments to the muscles of flight.

To the side pieces all the appendages, such as the legs and wings, are attached. In order that the legs may move freely on the body, and thus give play to hundreds of minute muscles within the legs, these side pieces are subdivided into several smaller sections. Were this not so, and the crust forming the exterior of the insect unbroken, thus forming a continuous series of cylinders, we should have the poor victims of this stern law of morphology enclosed in jackets of the straightest sort!

Whence comes, then, all the grace and perfect freedom of action seen in the vivacious motions of the Ichneumon fly and Butterfly? It lies in the fact that the whole outer crust is subdivided into portions which are finely hinged together by a tough membrane, forming points of attachment to thousands of little muscular fibres within, and thus giving the otherwise rigid crust a surprising degree of flexibility.

The three pair of legs are inserted at the lower edge of the side-piece (episternum, Fig, 6, ES), as seen in the figure, and the wings grow out between the upper side piece, (Fig. 6, EM) and the tergum (Fig. 6, T). The body of all known insects consists normally of twenty of these cylindrical rings, each of which is theoretically subdivided in the manner we have shown; but towards each extremity of the body, as in the rings composing the head and tail, but a part of the ring is developed, since the remaining portions have, during the development of the animal, either while still in the egg, or during its growth afterwards, become absorbed, and have consequently disappeared. In the head of all insects there are, as a rule, seven such rings, in the thorax three, and in the hind body, or abdomen, at least ten, and perhaps eleven, elemental segments. Counting, in addition to the great number of pieces which compose the trunk, the numerous joints of the legs, and those of the antennæ, which approach in the Cockroach to nearly a hundred in number, we can form some idea of the exceeding complexity of the insectean crust. Thus descriptive entomology has to take account of several hundred distinct parts, which by their relative size and position, produce the immense range of variation existing in nearly half a million species which are estimated to be scattered over the face of the earth,

besides those entombed in its crust, as fossils, which can never be numbered.

Thus the idea of articulation, upon which Cuvier founded this branch of the animal kingdom, which begins so simply in the worm and grows far more complex in the crab and its allies, is, in the insect, carried out with a bewildering richness and profusion of detail. It is like comparing a savage's "dug out" to the "Great Eastern" steamship, or the rude wigwam of an Indian to the Cathedral of Milan.

The German Naturalist Oken, who in his writings has so often anticipated the results of subsequent laborious inquiries, said in his aphoristic style when discoursing of insects: "Every fly creeps as a worm out of the egg; then by changing into the pupa, it becomes a crab, and, lastly, a perfect fly." The motions of these worms and crabs to which he aptly compares the two stages of the young fly, will show a farther analogy, though to many it may seem fanciful, between these forms of jointed animals. Worms wriggle along as they move. Now wriggling is one of the lowest forms of locomotion. The waddling of geese partakes of the same nature. In worms, the many rings of the body, so similar to each other in form and size, move on themselves, and then move all together, and thus the creature progresses. In pupæ the abdomen moves upon the forward part of the body; the insect *jerks* about by the motive power residing in the abdomen. Here is indeed a localization of the power of motion, and something is gained in the rising scale. Now the Crustacea, or crabs and their allies, all move by jerking. Watch the microscopic Cypris or larger Cyclops, in its swift circumnavigation of a drop of water. It moves both by its thoracic legs, and by the locomotive

power of its abdomen or hind-body, as it swims through its little "world of waters" by jerks. So also the Amphipod, a crab-like being, higher in the scale than the water flea, darts from weed to weed in the clear cool waters of tidal pools, by most gracefully jerking its abdominal rings. So also the clumsy crab clambers cautiously obliquely backwards over the pebbles by a jerking sort of gait; and the lobster carelessly bends its tail beneath its breast, and like a flash, lands softly a fathom away, in its course leaping the Laminaria swaying to and fro in the ebbing tide.

Compare with these stiff and clumsy motions, the flight of a swallow-tailed Butterfly, as it emulates all the motions of an eagle in its majestic flight over forests and through sequestered glades. The lowest of butterflies, the small dun colored Hesperiadæ, or Skippers, *jerk* as they fly. Or compare again the swift, vivacious, inquisitive motions of an Ichneumon fly, just as it has alighted upon a leaf. See the intensity of life in every movement of its open, restless wings; the head turning this way and that, with the vibrating feelers and threadlike waving antennæ, prompted by the nervous energy within; its arching abdomen directing each incessant and swift darting movement of its ovipositor, while running from leaf to leaf in its anxious search for some unlucky caterpillar in which to lay its eggs. In this tiny insect is a specialization of motion in every limb and section of its body, to which no lower articulate can attain.

Thus we see a certain degree of correspondence between the various modes of locomotion of the different groups of animals and their position in nature.

THE AMERICAN SILK WORM.

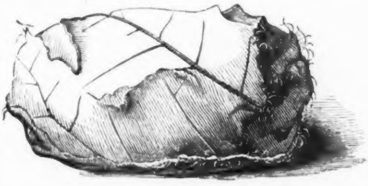
BY L. TROUVELOT.

(Continued from page 38.)

It is astonishing how rapidly the larva grows, and one who has no experience in the matter could hardly believe what an amount of food is devoured by these little creatures. One experiment which I made can give some idea of it: when the young silk worm hatches out, it weighs one-twentieth of a grain; when

10	days old it weighs	½ a grain,	or	10	times the original weight.
20	" " " "	3 grains	"	60	" " " "
30	" " " "	31 "	"	620	" " " "
40	" " " "	90 "	"	1800	" " " "
56	" " " "	207 "	"	4140	" " " "

When a worm is thirty days old it will have consumed about ninety grains of food; but when fifty-six days old it is fully grown and has consumed not less than one hundred and twenty oak leaves weighing three-fourths of a pound; besides this it has drank not less than one-half an ounce of water. So the food taken by a single silk worm in fifty-six days equals in weight eighty-six thousand times the primitive weight of the worm. Of this, about one-fourth of a pound becomes excrementitious matter; two-hundred and seven grains are assimilated and over five ounces have evaporated. What a destruction of leaves this single species of insect could make if only a one-hundredth part of the eggs laid came to maturity! A few years would be sufficient for the propagation of a number large enough to devour all the leaves of our forests.



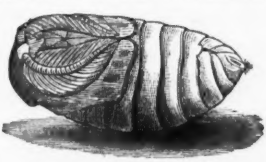
Cocoon of *Telea Polyphemus.*

When fully grown, the worm which has been devouring the leaves so voraciously, becomes restless and crawls about the branches in search of a suitable place to build up its cocoon; before this it is motionless for some time, holding on to the twig with its front legs, while the two hind pair are detached; in this position it remains for some time, evacuating the contents of the alimentary canal until finally a gelatinous, transparent, very caustic fluid, looking like albumen, or the white of an egg, is ejected; this is a preparation for the long catalepsy that the worm is about to fall into. It now feels with its head in all directions, to discover any leaves to which to attach the fibres that are to give form to the cocoon. If it finds the place suitable, it begins to wind a layer of silk around a twig, then a fibre is attached to a leaf near by, and by many times doubling this fibre and making it shorter every time, the leaf is made to approach the twig at the distance necessary to build the cocoon; two or three leaves are disposed like this one, and then fibres are spread between them in all directions, and soon the ovoid form of the cocoon distinctly appears. This seems to be the most difficult feat for the worm to accomplish, as after this the work is simply mechanical, the cocoon being made of regular layers of silk united by a gummy substance. The silk is distributed in zig-zag lines of about one-eighth of an inch long. When the cocoon is made, the worm will have moved his head to and fro, in order to distribute the silk, about two hundred and fifty-four thousand times.

After about half a day's work, the cocoon is so far completed that the worm can hardly be distinguished through the fine texture of the wall; then a gummy resinous substance, sometimes of a light brown color, is

spread over all the inside of the cocoon. The larva continues to work for four or five days, hardly taking a few minutes of rest, and finally another coating is spun in the interior, when the cocoon is all finished and completely air tight. The fibre diminishes in thickness as the completion of the cocoon advances, so that the last internal coating is not half so thick and so strong as the outside ones.

During the process of spinning, the worm contracts and diminishes in size, as the silk reservoirs empty. Six or eight days after the beginning of the cocoon, the worm casts its last larva-skin, and then appears under a very different form—a transitory one, which is neither worm nor moth; it is the chrysalis or pupa. When the chrysalis comes out of the larva skin, if observed closely, it will be seen that its resemblance to the perfect insect is striking; the antennæ, the head, the legs and abdomen resemble very much those of the moth. The wings only, are very small, but in a few minutes they grow to about half the size of the abdomen. The legs of the chrysalis, at least the tarsi, are enclosed in the articulated leg of the larva, the wings are folded under the skin of the second and third segments, and the antennæ are rolled up in the lobes of the cranium. When the chrysalis comes out, every part is detached and free, and if then put in alcohol they will remain so; but when left to its natural course it will soon be observed that a general envelope covers the whole chrysalis, and that any motion of the legs, wings and antennæ is impossible, since the insect is contained in the hard brownish envelope secreted by its tegument, and



Pupa of *Telea Polyphèmus.*

now resembles an Egyptian mummy. If before the shell of the pupa has become hard, an antenna, a leg or a wing be changed from the position that the insect has given to it, that part of the body which would otherwise have been covered by the part removed out of place, will remain of a different color and of a thinner consistence, and an insect thus treated will not generally live to arrive at the imago state.

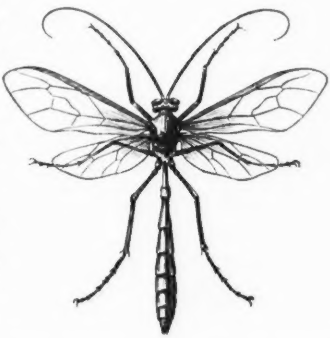
Before the last transformation is accomplished, the insect takes a long rest, and this period is the longest of its life; if it can be called an existence to live without eating, breathing, or even, probably, without having any distinct sensation. The pupa spends about nine months in this torpor, and braves the hardships of winter, notwithstanding all the changes of the temperature, being frozen as hard as a stone. It is only when the warm spring days come that life awakens, and the pupa is transformed into a perfect insect.

If a worm be opened longitudinally, even when half grown, there will be found in the female a vast number of little globular white bodies attached to a fine tube on each side of the stomach. These little bodies are the eggs of the future female moth, as yet in a rudimentary state. This is the only method of distinguishing the female from the male, while in the larva state. I have never been able to find any other character by which to distinguish the sexes. Again on making the same dissection of the larva, there will be found on each side of the stomach, and running from head to tail, two long secretory reservoirs, making a great many convolutions. These are the silk reservoirs. The transparent liquid they contain is the silk, as yet in a liquid state. If one of these vessels be taken out carefully and stretched, it will mea-

sure twenty five inches in length; these two reservoirs become very narrow as they approach the mouth, and unite together, terminating in a special contractile organ, attached beneath the mouth. When spinning, the silk is thrown out from the two reservoirs at the same time, and the thread is in reality composed of two distinct fibres which can be easily separated.

The silk in the reservoirs is sometimes used in commerce, being sold under the name of "gut." The process of obtaining the gut is very simple; it consists in preparing worms ready to spin by putting them in strong vinegar for eighteen hours; a transverse opening is then carefully made on the under side and about the middle of the body, taking care not to injure the silk reservoirs which are very distinct. The glands, or reservoirs, are then taken out and stretched parallel to each other on a board, and dried in the shade for several days.

The Enemies of the Silk Worm. Birds are the most formidable foes to the silk worm, especially the Thrushes, Cat-birds and Orioles. It is probable that ninety-five out of a hundred worms become the prey of these feathered insect-hunters. Toads and snakes also destroy some, and mice, rats, moles and squirrels eat the chrysalis enclosed within the cocoon. Among insects they have many enemies, such as various spiders, ants, bugs and wasps; but their most



Ophion macrurum Linn. Ichneumon Parasite on the larva of *Telea Polyphemus.*

dangerous foe is the Ichneumon fly. A Tachina-like fly also deposits its eggs in the body of the larva. The Ichneumon flies can be seen in summer flying about bushes in search of caterpillars in which to deposit their eggs, and I have observed them often flying for an hour among shrubs where no worms were feeding, for which they searched carefully, peering under almost every leaf. When an Ichneumon detects the presence of a worm, she flies around it for a few seconds, and then rests upon the leaf near her victim; moving her antennæ very rapidly above the body of the worm, but not touching it, and bending her abdomen under the breast, she seizes her ovipositor with the front legs, and waits for a favorable moment, when she quickly deposits a little oval white egg upon the skin of the larva. She remains quiet for sometime and then deposits another egg upon the larva, which only helplessly jerks its body every time an egg is laid on it. She thus lays some eight or ten eggs which adhere so firmly to the skin, that it is very difficult to take them off. After several days these eggs hatch out, and the small white larvæ may be seen at work as soon as they are out of the eggs, digging their way under the skin of the worm, on whose fatty portions they feed. The caterpillar, however, continues to eat and grow, and lives long enough to make its cocoon, but when once enclosed in it, the parasites which prey upon it have already eaten the fatty portions, and now attack the vital parts of the larva, which they speedily consume, and finally the one that outlives the others makes a cocoon within that of the Polyphemus larva. But it is a remarkable fact that here the maternal instinct of the Ichneumon fly makes a terrible mistake. Several of the Ichneumon larvæ have entered the worm, but only one

of them can find food enough to enable it to arrive at maturity; so probably the strongest one devours its weaker brethren when food becomes scarce, or else they die from hunger.

Description of the larva of Polyphemus. When fully grown this larva measures over three inches in length, and the body is very thick. The head is of a light chestnut brown color; the body of a handsome transparent light yellowish green, with seven oblique lines, of a pale yellowish color, on each side of the body; the segments are each adorned with six tubercles, giving rise to a few hairs, which are tinted sometimes with orange, with a silvery spot on the middle; there are six rows of protuberances, two on the back and two on each side, and the oblique lines run between the two rows of lateral tubercles uniting the lower one to the upper one by a yellowish line. The underside of the body is longitudinally striped with a faint yellowish band; the spiracles are of a pale orange color, and the feet are brown. The posterior part is bordered by a purplish brown angular line similar to the letter V.

Description of the Pupa. The pupa is much of the form and size of a robin's egg; the color is dark chestnut-brown, with a pale greenish spot at the base of the antennæ. The form of the legs, wings and antennæ are distinctly marked, while the posterior part is furnished with a brush of minute hooks.

For a description of the Moth (*Imago*) see the Synopsis of Lepidoptera, by Dr. J. G. Morris*, only observing that there are at least six varieties: the yellow, the ferruginous, the brown, the greenish, the pale cream color, and another variety with the black lunule on the secondaries replaced by a ferruginous spot. The male can be easily

*Published by the Smithsonian Institution, Washington, D. C.

distinguished from the female by its lighter form, and by its smaller abdomen, which is not so highly coloured as that of the female; but the most striking difference is in the antennæ; those of the male are pectinated, broad, and like two feathers adorning the head, while those of the female are narrow and very much smaller.

Description of the Egg. The egg is about one-tenth of an inch in diameter, almost cylindrical, with the two ends convex. The cylindrical surface is brown, with a narrow white spot about one-half the width of the egg; the two convex parts are white. One hundred of them weigh on the day they are laid, eight grains, but an evaporation of the fluid contents of the body takes place, and on the day the young hatch out, the same number weigh only six and two-third grains. One hundred and ten empty shells weigh one grain; about six thousand worms are equivalent in weight to one ounce. I will now proceed to give some instructions as to the rearing of the worm. They will be easily understood, if I have been clear enough in explaining the natural history of the Polyphemus Silk Worm.

Selection and preservation of Cocoons intended for Stock. The cocoons' intended for the propagation of the species for the following year, should be carefully selected. As a general rule the female larva is larger than the male; so the cocoon of a female is also larger than the male cocoon. I estimate a cocoon to be a very good one, and the pupa within healthy, when it is heavy for its size, and resists well the pressure between the fingers, not being deformed by it. About one-half of the number intended for propagation should be selected from among the largest; very probably the majority will be females. The other half should be selected, not among the largest, nor

the smallest, but among the intermediate ones. When properly selected, they should be placed beyond the reach of rats or mice, in boxes, baskets or bags. The boxes should be stored in a cold, dry room, or cellar, where the temperature does not get above forty-five degrees, for if the temperature be higher, they will be liable to hatch before winter. While the temperature should not go above forty-five degrees, it can descend indefinitely without injury to the pupa.

Hatching out of the Moth. Towards the end of May, in the latitude of Boston, the temperature sometimes reaches seventy degrees. I have said above, that a heat of fifty or fifty-five degrees continued for some time, is sufficient to put in activity the causes which transform the pupa to perfect insects. So about the middle of May, the cocoons should be taken out of the cellar and put into the hatching room, as the time approaches when the perfect insect will appear out of its prison. Tables or shelves should be placed in the hatching-room to lay the cocoons upon. They should be spread out, and not piled one upon the other, as the insect in coming out would get to the surface with difficulty. Over the tables or shelves where the cocoons are placed, should be hung pieces of cloth, or net, to which the insect can easily attach its hooks, for the purpose of allowing its wings to develope. The perfect insect rarely comes out before noon, and very few after five o'clock in the afternoon. One should watch the process of exclusion, in order to help the insects when they do not readily find the net, or cloth to cling to, and also to remove those which disturb others whose wings are already expanding. The rays of the sun should not fall directly upon the cocoons, as the heat would cause a rapid evaporation, which would certainly kill the chrysalis.

Towards the evening of the day on which the moths leave their cocoon, an equal number of both sexes should be placed in the same cage, and after pairing, the females should be kept until they die, which will occur in four or five days after their union. The eggs which are stuck to the cage with gum, should be scraped off with a wooden, or whalebone knife, and then spread in a large pasteboard box to dry thoroughly. A ticket, with the date stating when the eggs have been laid, should be put upon the box, so as to indicate the day the worm will probably hatch.

The length of the period of incubation depends entirely on the temperature, but in June, the incubation generally lasts twelve or thirteen days, while in August the period is two days shorter. Eight or ten days after the eggs have been laid, they should be placed in the hatching box, which should be made of tin, and about three inches long, two inches broad, and one and a half inches deep. In the middle, a narrow longitudinal band of tin should be soldered, and bent so as to form a hook by which the box may be hung to some twig or branch. The box should be painted, and before it is dry sand should be sprinkled over it, so as to make a rough surface upon which the worm can crawl with ease.

The larvæ hatch out from five to ten o'clock in the morning, and the attendant should be ready at that time, to place the box upon a branch which has its extremity in the water. A thousand of the little worms can feed upon a branch of moderate size for four or five days, and when it is well covered with them the box may be removed to another branch. The larvæ feed equally well upon the different species of oaks, maples, willows, poplars, elms, hazels, birches, blueberry and other plants, without affecting the quality of the silk.—*Concl. in May No.*

THE LAND SNAILS OF NEW ENGLAND.

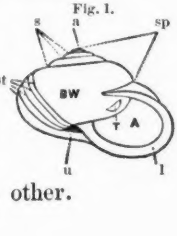
BY EDWARD S. MORSE.

(Continued from page 16.)

We commence the specific description of the Land Snails of New England with a group of the larger forms, of which *Helix albolabris* offers a fair example. It would be more natural to present first a chapter on the classification of the animals to be considered, but we think it better that our readers should first become acquainted with the forms to be classified, that they may the better understand and appreciate the principles upon which the species are grouped into genera and families. In fact, more or less familiarity must be acquired on the general and special history of any group of animals before one can clearly comprehend its classification.

It would be proper that the slugs, or those snails without external shells, should first engage our attention; owing however to the want of sufficient material for accurate figures, we prefer waiting till the spring opens, and an opportunity is afforded to examine fresh specimens, before presenting a chapter on this group. In order that the descriptions of the following species may be understood, we present an explanation of the various terms used in describing shells (see fig. 1). The explanation of the soft parts of the animal was given in the first number.

Fig. 1.



Spire, sp., includes the twists, or whorls of the shell, excepting the last or outside whorl, which is called the *body whorl*, BW. The spire is said to be *elevated*, when the apex and whorls rise above the body whorl, and *depressed* when the whorls do not rise above each other.

Apex, a, is the beginning of the spire, or the part first formed.

Base, is that region of the shell opposite the apex. A shell rests on its base, when the apex is uppermost.

Suture, s, is the seam, or line of division between the whorls.

Umbilicus, u, is a cavity left in the central axis of the shell, around which the whorls revolve. The umbilicus is seen from the base of the shell. The umbilicus is said to be *open* when a distinct perforation appears in the base of the shell; *closed*, when a portion of the lip extends over it, (as in the adult condition of the shells of many species), and *absent*, when the whorls revolve so closely as to leave no central space.

Lip, l, is the border of the aperture. When the edge of the aperture is sharp, the lip is said to be simple. When produced into a flange, it is called a reflected lip.

The *columella* is that portion of the aperture nearest the centre of the shell.

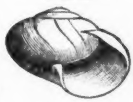
Striæ, st, or lines of growth, are minute lines, running parallel with the border of the aperture, and indicate the successive enlargements of the shell.

Nearly all shells have an outer coating of animal matter, called the epidermis. After the death of the animal this coating soon loses its color, and wears away, leaving the shell faded and bleached.

HELIX ALBOLABRIS *Say*. The general description of this species given in our first number need not be repeated here. Described first by Thomas Say, one of the earliest naturalists of America, it has always been a standard species, quickly recognized by its beautiful russet-colored shell, and the broad white lip bordering the aperture. The animal is variable in color, though generally light-

brown, or greyish. The granulated markings on the body are very distinct. The shell is uniformly light yellowish or russet brown, having from five to six whorls. The aperture is bordered by a broad white lip in adult specimens; the lower portion of the lip extending over the umbilicus. Fig. 2 represents the shell before it has attained its complete growth; the umbilicus is open, and the lip is sharp. The presence of a reflected lip, in those species which have it, always indicates maturity.

Fig. 2.



The ordinary diameter of the shell is one inch, though it sometimes attains a larger size.

This species occurs throughout the United States, with the exception of the Pacific coast and the extreme Southern States. They are found in well wooded districts of oak, maple and beech, and oftentimes occur in great numbers on islands. They can be easily kept in confinement, and the shells of those raised in this manner are much more symmetrical and delicate, than those found wild. In order to raise them, it is only necessary to procure a wooden box, or better, a deep earthen bowl, and after filling to the depth of two inches with damp earth from the woods, place a few bits of bark for the snails to lurk under. It is well to imitate as nearly as possible the condition of their native haunts. As the earth becomes dry, moisten with a sprinkling of water, bathing the snails at the same time. They may be fed on flour or meal mixed with water, and occasionally a tender leaf of cabbage or lettuce, of which they are very fond. The young can be easily raised from the egg by observing the above conditions. The eggs, from thirty to fifty in number, are laid in early spring, and hatch in the space of three or four weeks. The snail when first hatched from the egg,

is quite unlike its parent. They attain their complete growth, in from two to three years.

HELIX THYROIDES *Say*. (Fig. 3). The shell of this species resembles very much that of Helix albolabris, but differs in being smaller, slightly more globose, and in having its umbilicus only partly covered. The chief point of difference lies in the prominent tooth-like process on the inner lip. The shell is yellowish horn color; whorls five, finely striated with lines of growth; aperture bordered by a broad white lip; inner lip furnished with a white tooth; umbilicus only partly closed; diameter three-fourths of an inch. Dr. Gould says that, though by no means common, this shell occurs in nearly all parts of Massachusetts. It must be considered a rare shell in New England, though it is a very common species in New York, the Western and some of the Southern States.

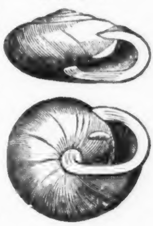
Fig. 3.

HELIX SAYII *Binney*. (Figs. 4, 5). This species was named by Dr. Amos Binney, in honor of Thomas Say. The shell is depressed and thin; color shining russet; whorls five, or six; aperture rounded, bordered by a narrow white lip, with a slight projecting tooth near the umbilicus. There is also a prominent white tooth on the inner lip; umbilicus open, allowing all the volutions to be seen; diameter nearly one inch. The animal is light reddish brown, with the tentacles darker. This species, though generally distributed throughout the northern portion of the United States, is by no means common in New England. It has been found in Vermont, New Hampshire,

Figs. 4, 5.

and several places in Maine. It seems to prefer mountain slopes and hill sides. We have picked up the empty shell in numbers, on hill sides that had recently been burnt over, and the collector will often find clearings of this nature, that is where a light hardwood growth has been recently burnt, a good collecting ground for the larger Helices, as the leaves under which they hide become burnt, and the snails are thus exposed, oftentimes uninjured. We extract the following from Binney's Monograph of the Land Snails of the United States, p. 181: "On the third day of July, 1836, I discovered an individual of this species in the act of laying its eggs, in a damp place under a log. I transferred them, with the animal, to a tin box filled with wet moss. The eggs were not much more than half as large as those of *H. albolabris* Say; they were white, adhering together very slightly, flaccid, and apparently not entirely filled with fluid. During the succeeding night the number had increased to about fifty, and in a few hours they became full and distended. As the Snail now began to devour the eggs, I was obliged to remove it. On the twenty-ninth of July, all the eggs were hatched: the young snails had one whorl and a half; the umbilicus was open; the head and tentacles were bluish-black, and the other parts whitish and semi-transparent. They immediately began to feed, and made their first repast of the pellicles of the eggs from which they had just emerged. They grew rapidly, and before the middle of October, when they went into winter quarters, they had increased their bulk four or five times, beyond their original measurement."

Figs. 6, 7.



Helix dentifera *Binney*. (Figs. 6,7). Shell with spire flattened, convex below,

whorls five, with delicate oblique striæ; the aperture is flattened towards the plane of the base. The lip is broad and white, inner lip having a prominent tooth; diameter three-fourths of an inch. The animal is grayish on the sides, with the back darker. This species may justly be considered rare, as wherever it occurs, it is generally found sparingly. Dr. Binney found it on the eastern slopes of the Green Mountains. They were at one time numerous in the town of Stratford, Vermont. Four specimens only have been found in Maine, and these were discovered either on the slopes or summits of mountains. It has never been collected in Massachusetts to our knowledge. It occurs in Ohio, New York and Pennsylvania.

It will be hardly necessary for me to state, that the descriptions already given, and those which are to follow, are mainly intended for those who are forming, or wish to form collections in this pleasing branch of Natural History. To such we feel that no apology is needed for the necessary dryness of specific descriptions, and we know that the figures will be acceptable, as the works in which these species are illustrated are rare and expensive, and many of them have not heretofore been given with any approach to accuracy. We hope that no little interest may be excited in those not directly interested in the subject, as illustrating a group of animals but little known to general readers, and affording them some conception of what may be found under the dead leaves, and rotten bark, crushed beneath the feet while rambling in the woods and fields.—*To be continued.*

REVIEWS.

Preliminary Report of the Geological Survey of Kansas. *By G. C. Swallow, State Geologist.* Lawrence (Kansas), 1866. 8vo.

Besides the General Report by Professor Swallow, this preliminary summary of the results of the Survey of Eastern and Central Kansas, contains special reports upon the economical Geology of ten counties, by Maj. F. Hawn, with Reports upon the Climatology of the State, by Dr. Tiffin Sinks, and upon the "Sanitary Relations of the State," by Dr. C. A. Logan.

If the survey had merely established the presence of extensive deposits of Gypsum, Salt, or Coal, it would have thrice repaid its expense to the State. Incalculable wealth may result from a proper use of these discoveries, and the attractions they offer to the capital and labor of the east are very great. The soils of the numerous valleys, and the centre of the State overlying the bands of Triassic and Permian beds, with their "gypsum marls," are described as extremely rich. Even the Coal Measures, here unusually productive, are covered by the bluff formation which makes "the very best soils of the State." The purely scientific interest of the Report we have no space to mention; it is almost wholly devoted to Economical Geology, and in this respect partakes of the general want of completeness manifested in many of our State Reports. This is in no way attributable to their scientific authors, but to the very limited pecuniary aid given them by our legislators. This must necessarily render many of our State reports superficial, and greatly inferior in point of information and economical value to what they might be, were the work of the American Geologist properly supported, both by popular sympathy and proper pecuniary encouragement. With a few honorable exceptions, the State appropriations for Geological surveys, have barely enabled the Geologist to make even the most superficial reconnoissance. It is to be hoped, now that several States are again appropriating funds for Geological, Zoölogical and Botanical Surveys, the means afforded may be ample. The United States Coast Survey has surpassed all similar undertakings in Europe. Why may not the Geological explorations and the construction of Geological maps be carried on with the same energy and equal success, both in a scientific and pecuniary point of view?

Annual Report of the Board of Regents of the Smithsonian Institution for 1865. *Washington,* 1866. 8vo.

There are but few naturalists, especially those residing away from the scientific centres of our country, who have not been aided and en-

couraged in their studies, either by the private correspondence or published works of the Smithsonian Institution. How many young naturalists, and we speak from personal experience, scattered over the country, away from libraries and the stimulus of scientific intercourse, owe to this Institution, founded by the bequest of James Smithson, of England, "for the increase and diffusion of knowledge among men," a great part of their success in investigating natural phenomena!

No institution known to us, in any land, has by such a wise and economical management of its funds, done so much for the advancement of all departments of science. This has been accomplished by the wide and generous distribution of its numerous publications, the use of its large and unique library of scientific periodicals, its duplicates from the Museum of Natural History, and its loan, necessarily guarded, of meteorological instruments, together with its ready aid to those conducting original investigations, and by its general sympathy with the highest scientific culture.

The present volume, printed and distributed as a Congressional document, contains beside the annual statement of the accounts and doings of the Institution, articles of general interest. Among such are the eulogies on General Joseph G. Totten, the conchologist and eminent military engineer, and on Ducrotay de Blainville, the student, unsuccessful rival, and finally the successor of Cuvier in the Jardin des Plantes. There is also an account of the Aurora Borealis or Polar Light, by Professor Elias Loomis; an article on the Senses, translated from the German periodical *Aus der Natur;* lectures on Electro-Physiology, by Professor Carl Matteuci, of Turin, and a very full account by Professor E. Desor, of the "Palafittes, or Lacustrian Constructions on the Lake of Neuchatel," an article of great interest at present owing to the discussions on the antiquity of Man. Throughout the text are distributed numerous cuts illustrating the implements of the age of Stone, of Bronze and of Iron. The report of this able and cautious investigator brings out clearly the fact "that it was the same people who inhabited our soil [Switzerland] during the ages of Stone, and of Bronze, and up to the time of the invasion by the Helvetians."

AMERICAN JOURNAL OF CONCHOLOGY. *Edited by G. W. Tryon, jr.,* Philadelphia. Published quarterly at $10 per year.

The second volume of this Journal, illustrated by twenty-seven colored and plain plates, is completed. It contains many valuable articles by the leading Conchologists of this country, and will be found useful to all studying the Mollusca.

NATURAL HISTORY MISCELLANY.

BOTANY.

THE TERTIARY FLORA OF BROGNON.—Mr. Saporta communicated recently to the Geological Society of France a paper on the flora of a small tertiary basin, at Brognon, north-east of Dijon, in the department de la Cote d'Or, the following abstract of which is from *L'Institut* of July 25:—"The vegetable remains are referable to 13 species of 12 genera, which are *Flabellaria*, *Quercus* (2), *Migrica*, *Ficus*, *Cinnamomum*, *Andromeda*, *Acer*, *Ilex*, *Zizyphus*, *Xanthoxylon*, *Cercis*, *Pecopteris*. The last genus is allied to two ferns, living in the Brazils and at the Cape; the two oakes have their analogues in Louisiana and Guatemala; the fig has its in Eastern India and in Java, *Cercis* and *Cinnamomum* ally this flora to that of Japan; the jujube to that of Timor; *Andromeda* to that of the Isle Maurice. The maple and the holly still live in the Mediterranean region. Floras of a like character are found preserved at Armissan, Manosque, Monod, Œningen, in the 'gypses d'Aix,' and in the Swiss 'Molasse.'"

The author concludes as follows:

1st. That during the period when the flora of Brognon flourished, there was in this locality a fresh water lake, very rich in calcareous sediments by the agency of which the remains of plants living on the margins of the lake have been preserved.

2nd. That the age of the lake may be determined by comparison with analogous deposits; it should probably be placed in the Lower Miocene.

3rd. That this flora consists of a mixture of tropical and temperate forms, and such that characterize the plateaus of Mexico and Central America; and that the temperature of Europe, during the Miocene epoch, was similar to these regions.—*R. Tate, Hardwicke's Scientific Gossip, Oct.* 1, 1866.

DRYING FLOWERS BY HEAT.—Twenty years ago, when botany was my hobby, I adopted a plan for drying my specimens, which was both rapid and very effectual in preserving colours. I borrowed a tin dripping pan from the cook, which was just the size of my sheets of blotting-paper. In this I laid the produce of the day's excursion between sheets of blotting-paper in the usual way, and when the pile was complete I covered it over with a layer of common scouring sand half an inch thick, so that the tin dish appeared to be simply full of sand. I then placed it on the kitchen fender, or on the hob, or in the oven if it were not too hot, and in three or four hours the whole batch of specimens was perfectly dried. It required a little care to take them out at the right moment, when they were baked just enough, and not too much; but this care being given, the success of the plan was perfect. Many specimens still in my herbarium bear witness to the superiority of such rapid drying over the old method."—*F. T. M. Loborough.*

Another Method.—"I have adopted the plan of drying flowers by heat for some years, on the recommendation of a friend. With some plants

it acts very well, but not with others. Much depends on the mode of doing it. It should be done *gradually*, and with an iron *not too hot.* My friend told me that he had taken nearly two hours in thus drying a plant, but he found himself well rewarded. I have *Orchis fusca* now that I ironed out in 1863, and it has lost very little of its colour. *Ophrys muscifera* looks well ironed; so do grasses."—*Henry Ullyett. Hardwicke's Scientific Gossip, Aug.* 1, 1866.

ZOÖLOGY.

FLIGHTS OF BUTTERFLIES.—In Europe, we have had notices of remarkable flights of swarms of butterflies; but Sir Emerson Tennent, in his work on the Natural History of Ceylon, has related similar instances of "flights of these delicate creatures, generally of a white or pale yellow hue, apparently miles in breadth, and of such prodigious extension as to occupy hours and even days, uninterruptedly in their passage":—

"The butterflies I have seen in these wonderful migrations, in Ceylon, were mostly *Callidryas hilariæ, C. Alcmeone* and *C. Pyranthe*, with straggling individuals of the genus *Euplœa, E. Coras* and *E. Prothoe.* Their passage took place in April or May, generally in a north-easterly direction. A friend of mine travelling from Kandy to Kornegalle, drove for nine miles through a cloud of white butterflies, which were passing across the road by which he went." p. 403.

GEOLOGY.

THE FIRST APPEARANCE OF MAN ON OUR PLANET.—"Although perhaps more interesting in an ethnological than in a geological point of view, we cannot altogether exclude from our notice the phenomena attending the first appearance of Man on our planet. The discoveries of the last few years have satisfactorily shown that the opinions formerly entertained of a great break existing between the period when the now extinct races of Mammalia dwelt in our land, and the first creation of man, are no longer tenable. Here also we have been obliged to give up the theory of great breaks between successive formations. As we find a gradual passage from one geological formation to another evidenced by the *gradual* dying out of the pre-existing forms of animal life, and the *gradual* introduction of newer, and generally higher, forms (although we do not yet understand the law of such progressive changes), so, when we come to the most recent, or Quaternary, periods in geological chronology, we find evidence of Man's existence on the earth before the final disappearance of those varied forms of mammalian life which have hitherto been generally looked upon as belonging to the final period of the geological cycle. Thus Man of the present day is connected by an almost unbroken series of links with

the recently discovered Foraminifera of the Laurentian gneiss."—*Anniversary Address of the President (Sir R. I. Murchison) of the Geological Society of London.* 1866.

THE EOZOÖN IN AUSTRIA.—"Prof. Hochstetter, after long and laborious search, has succeeded in finding, in the crystalline limestone of Krummau, in South-western Bohemia, agglomerations of calcareous spar and serpentine, which have been declared by Dr. Carpenter, to whom specimens had been sent for examination, to be undoubted remains of *Eozoön*. Professor Hochstetter thinks the lenticular nodules partly composed of calcareous spar and serpentine, so abundant in the vicinity of the graphitic beds of Schwarzenbach and Mugerau, to be possibly of organic origin. Prof. Gümbel has lately found the *Eozoön* in the crystalline limestones of Bavaria."—*Quarterly Journal of the Geological Society*. London. 1866.

The *Eozoön* is the earliest form of animal life known; it belongs to the lowest type of animals, the *Protozoa*, and has only been found in the oldest rocks on the globe: i. e., the Laurentian System, consisting mostly of gneiss, limestone and syenitic rocks. It was first discovered in Grenville, Canada, by the Canadian Geological Survey, and afterwards in Connemara, Ireland.

CORRESPONDENCE.

WASPS AS MARRIAGE-PRIESTS TO PLANTS.—"Among these Wasps (though technically not a wasp at all), is a fine, handsome insect which has greatly piqued my curiosity, because I have not been able to locate it, even as to its family. Can you inform me what it is? It is near the Sphegidæ, or the Scoliidæ of Westwood, but differs materially, I think, from both. I did not preserve any perfect specimen of the insect. Its striking peculiarities, in addition to its handsome appearance on the wing, or when settling on the flowers of the Asclepias, with its antennæ busily employed gently playing upon the outside of the flower, while the labium is as busy inside—are the elongated labium and the very singular appendages to the tarsus, a drawing of one of which, highly magnified, I enclose. I think from the appearance of the spines upon the tarsus, that nearly all of them have borne these appendages, which have been broken off of such as are now without them. The terminal lobe of the appendage is light green, while the enclosed granules (or cells) are

Pollen attached to the spines of a wasp's leg.

darker. Westwood (Classification of Insects, vol. ii., fig. 82, p. 197) figures from Savigny* a probably similar appendage to the maxillary palpus of one of the Larridæ, and surmises that it was the result of disease.

From the general appearance of these appendages, their existence on all of the tarsi, and on all of the insects of this species hitherto examined by me, I do not think they result from disease, but are characteristic of the insect."—*T. Chambers, Covington, Ky.*

The wasp is evidently allied to *Tachytes*, one of the Larridæ. We trust our correspondent will, during the coming season, secure specimens for accurate identification, and renew his observations on a point so interesting alike to the Entomologist and Botanist.

We sent Mr. Chamber's drawings to Mr. Horace Mann, of Cambridge, without stating that the insect had been seen on the Asclepias, who thus writes:

"I received your note, with the very interesting sketches in it, last evening. The masses which have attached themselves to the wasp's leg, are, as you suppose, pollen, that of some species of *Asclepias*, the Milkweed or Silkweed. By referring to Gray's Manual of Botany you will find the structure of the flowers described on p. 351, and by referring to his Systematic and Structural Botany you will see it figured on p. 459. I showed the drawings to Dr. Gray, who was very much delighted with them, and begs, as I do, that you will have a wood-cut made of the small one, to show what a quantity the wasp managed to pick up in his perigrinations. A cut reduced to half the size of the drawing would answer every purpose, and be very interesting and instructive to Botanists."

In our specimen of *Tachytes*, there are four pollen masses attached to the spines on two of the legs. They evidently adhered to the spine by the viscid base of the pollen mass. They agree well with the drawing of Mr. Chambers, of which we give a wood-cut reduced one-half.

In regard to works on the Hymenoptera, or bees, wasps, etc., of this country, you will find many species described in H. de Saussure's great work on the Vespidæ (Monographie des Guepes Sociales, Paris et Genève, 1853-58, 3 vols., 8vo). You will also find the Catalogue of Hymenoptera in the British Museum, by Frederic Smith, London, 12mo., vols. 1-4, to be an indispensible work. Many are also described in the new edition of Say's "American Entomology" and his other works edited by Dr. LeConte and published by Ballière Brothers, New York. Other papers describing many of our most common forms, are scattered through the Proceedings of the Entomological

*On comparing Savigny's original plate, the rounded masses are evidently pollen, which led us to suppose those on this insect to be of the same nature. Afterwards we found precisely similar masses of Asclepias pollen on *Tachytes aurulentus* Fabr., in the Museum of the Essex Institute.—Eds.

Society of Philadelphia, the Proceedings of the Essex Institute, the Boston Journal of Natural History, and the Annals of the Lyceum of Natural History of New York.—Eds.

NATURAL HISTORY CALENDAR.

New England Reptiles in April.—The month of gladsome sounds has come! The little "pee-weep-ing" Tree Toads, with their high-pitched whistling notes, will soon convince you of the fact, if you are so fortunate as to live without the city walls; for on the first balmy evening, when Nature seems to open her heart and voice, you will be strongly impelled to stroll beyond the limits of your recent walks, and be you ever so stoical, you cannot close your ear to the joyous sounds that will rise from every swamp, ditch, and pool.

Yes! the little Tree Toads have left their winter homes, and come forth to announce in joyful chorus that Spring is here; that the cold and dreary days are over, and to bid us welcome the bright and happy ones to come.

Let us accept the invitation and visit the spot where the little revellers of night invite us so cordially. With what joy do they seemingly anticipate our coming—what music to the sympathetic ear. Hark! ten thousand little throats are sounding their welcome. We are near them. Hush! all is still.—One timid, cautious note, *peep*, strikes our ears, and, regardless of prospective colds, we seat ourselves on the damp bank resolved to see the little musician; assuring the little pipers by our quiet and attentive attitude that we will listen to their song of joy and greeting. *Peep, peep*, comes from a spot not far away. Another *pee-e-p*, still nearer; then *pee-weep, pe-weep, pe-weep, pe-weep, pe-weep*, and the chorus is at its height. The thousand invisible musicians are satisfied that we love their sounds. Move not or all will be hushed; for these little minstrels are jealous of their right to a quiet audience, and to enjoy their music that right must be respected. Observe that miniature wave circling from that spear of grass quite near the bank; look closely there, and you will see a little pointed head rise cautiously above the water, and then,—*pee-weep*. Yes! there is one of the little fellows! and we return home gladdened by their music, and contented that we have discovered the character of these happy little choristers of spring, and have found them to be our little summer friends of the woods, instead of Turtles, as we have from our youth been told.

During the first week in this month, the Little Tree Toads (*Hyla*

Pickeringii Le Conte) will be out in abundance, and about the 10th or the 15th their eggs may be found attached singly to the floating vegetation; never in strings or masses, as is the case with all our other toads and frogs. In about twelve days the young are hatched, and are much further advanced in the tadpole state, than in our other species of frogs and toads, which do not have distinct tails, well marked heads, and the power of free locomotion for several days after they are hatched, and therefore remain during that period in the gelatinous mass surrounding the eggs; but the eggs of the Little Tree Toad not being provided with this jelly-like substance, the young are forced to swim about in search of food, as soon as they leave them, and are, therefore, more perfectly adapted to their period of "fish-life" from the first.

The peculiar half-grunts, half-croaks of the Wood Frogs (*Rana sylvatica* Le Conte) are first heard, generally, about the middle of the month in ponds or even temporary pools of water. In a few days their eggs are laid in masses about three inches in diameter, attached to spears of grass, and they leave the water for their summer abode in the damp and shady woods. The eggs are hatched in about six days, and the tadpoles, rapidly developing, attain the form of adults by the time the temporary pools are dry.

The Common Toads (*Bufo Americanus* Le Conte) usually appear from the 15th to the 20th of April, when their peculiar low trilling notes are heard in every direction for a month or two afterwards. Their eggs are laid in long double strings, from about the 20th of April to the middle of May, and often even as late as June, owing, probably, to the great distance many of the Toads have to travel in order to reach the water. The tadpoles are commonly hatched ten days after the eggs are laid.

The Spade-footed Toads (*Scaphiopus Holbrookii* Baird) are more uncertain in their appearance, being governed entirely by the dampness or dryness of the season, and are only found in isolated localities. Often appearing by the middle of this month, they may not, on a following year, come forth until a long summer's rain has made temporary ponds. Their appearance may be delayed even to the middle or last of July, and frequently several years will pass without their being noticed at all. When they do appear, it is always suddenly and in immense numbers. They remain but a day or two in the water, disappearing as mysteriously as they came; leaving behind them thousands of eggs, in bunches of from one to three inches in diameter. Generally these bunches are attached to spears of grass, though they were once observed floating freely in a temporary pond. The tadpoles come forth in about six days after the eggs are laid, and their growth

is very rapid, not more than two or three weeks elapsing before the young toads leave the water. The peculiar, harsh croaking of this singular toad must be heard to be appreciated, and can then never be confounded with that of any other species. The only sound we can liken it to is that of a heavily loaded, creaking wagon rolling over hard and uneven ground.

About the last of the month we have found singular bands of eggs, several inches in length, each band consisting of three irregular rows of eggs, which we have taken to be those of the large Tree Toad (*Hyla versicolor* Le Conte), whose low monotonous rolling note is heard throughout the summer, but we have never been able to confirm the supposition. The eggs collected did not solve the question, as all the tadpoles which were hatched from them in the course of five days, died before they exhibited the characters of any toad or frog with which we were acquainted; though in the tadpole state they were very much like the tadpoles of *Hyla Pickeringii.*

The other species of Frogs found in Massachusetts do not lay their eggs before May or June, though they all appear from the first to the middle of the month, and their various notes and peculiar croaks add much to the lively chorus of Spring. They are the Spotted Frog, Marsh Frog, or Pickerel Frog (*Rana palustris* Le Conte); the second species of Spotted Frog, Marsh Frog, or Field Frog (*Rana halecina* Kalm); the Green Frog (*Rana clamitans* Daudin); and the Bull Frog (*Rana Catesbyana* Shaw).

The several species of Salamanders (improperly called "Lizards") are also to be found either in water, or under stones and logs, in wet, or damp and shady localities, each according to its peculiar habits, but they do not lay their eggs until later in the season. The Turtles and Snakes also creep from their winter retreats, and are to be seen on bright sunny days endeavoring to warm their cold bodies after their long winter sleep.—F. W. P.

Ornithological Calendar for April. 1st to 10th.—The Pine and Yellow Redpoll Warblers, Ruby-crowned Kinglet, the Woodcock, Killdeer Plover; the Great Blue and Night Herons, the Bitterns, the Kingfisher, the Fish Hawk, Sharp-shinned, Cooper's and Sparrow Hawks commonly begin to make their appearance. Snow Birds, Song, Fox-colored and Tree Sparrows are more abundant than at any other period of the year. The last of the winter visitors are retiring. Geese and Ducks are passing in flocks to the northward.

10th to 20th.—During this time appear the Hermit Thrush (*Turdus Pallasi* Cab.), White-bellied Swallow, and the Golden-winged Woodpecker or Wakeup. Chipping, Field and Savanna Sparrows arrive; also, the Willet; the Tell-tales; the Least, Semipalmated, Solitary and

Spotted Sandpipers, Wilson's or English Snipe, Golden and Field Plovers. The Fox-colored and Tree Sparrows, Snow Birds, Pine Finches and Shore Larks mostly disappear, passing northwards. Robins, Song Sparrows, Carolina Doves, Meadow Larks, the Crow, and the smaller Hawks pair.

20th to 25th.—The Wood Thrush (*Turdus mustelinus* Gm.), the Purple Martin, Brown or Tit Lark, White-throated and White-crowned Sparrows, Virginia and Common Rails, the Marsh, Sooty and Wilson's Terns, the Green Heron and the Little Bittern arrive; some of them scarcely halting in their passage northward.

25th to 30th.—The Chewink or Towhee Bunting, Barn Swallow, Chimney Swift, Cat Bird, Black and White Creeper, Yellow-bellied Woodpecker, Least Flycatcher, Warbling and Solitary Vireos and the Whip-poor-will begin to arrive; not usually becoming common until a week or ten days later. Blue Birds, Robins, Grass Finches, Field and Song Sparrows, and Kingfishers are now nesting, or have occasionally even commenced incubation.—J. A. A., *Springfield, Mass.*

THE INSECTS OF EARLY SPRING.—In April the Gardener should scrape and wash thoroughly all his fruit trees, so as to rub off the eggs of the Bark Lice which hatch out early in May. Many injurious caterpillars and insects of all kinds winter under loose pieces of bark, or under matting and straw at the base of the trees. Search should also be made for the eggs of the Canker Worm and the American Tent Caterpillar, which last are laid in bunches half an inch long on the terminal shoots of many of our fruit trees. A little labor spent in this way will save many dollars' worth of fruit. The "castings" of the Apple Tree Borer (*Saperda bivittata*) should be looked for at the base of the tree, and its ravages be promptly arrested. Its presence can also be detected, it is said, by the dark appearance of the bark, where the grub is at work: cut in and pull out the young grub. It is the best time of the year to catch and kill this pest. Cylindrical bark borers, which are little round black weevil-like Beetles, often causing "fire-blight" in pears, etc., are now flying about fruit trees to lay their eggs; and many other weevils and boring-beetles, especially the Pea Weevil (*Bruchus pisi*), the Pine Weevil (*Pissodes strobi*), and *Hylobius pales* and *Hylurgus terebrans*, also infesting the pine, now abound, and the collector can obtain many species not met with at other times.

The housewife must now guard against the intrusion of Clothes' moths (*Tinea*), while many other species of minute moths (*Tineids*), and of Leaf-rollers (*Tortricidæ*), will be flying about orchards and gardens just as the buds are beginning to unfold; especially the Coddling Moth (*Carpocapsa pomonella*). On warm days myriads of these and other insects may be seen filling the air; it is the busiest time of their

lives, as all are on errands of love to their kind, but of mischief to the Agriculturist.

When the May Flower—"O commendable flowre and most in minde"—blooms, and the willows hang out their golden catkins, we shall hear the hum of the wild bee, as it

"Murmurs the blossomed boughs around,
That clothe the garden's southern bound,"

and the insect hunter will reap a rich harvest of rarities. Seek now on the abdomen of various wild Bees, such as Andrena, for that most eccentric of all our insects, the Stylops Childreni.* The curious larvæ of the Oil Beetle, *Meloe*, may be found abundantly on the bodies of various species of Bombus, Andrena and Halictus, with their heads plunged in between the segments of the bee's body.

The beautiful moth, *Adela*, with its immensely long antennæ, may be seen, with other smaller moths, feeding on the blossoms of the willow. The Ants wake from their winter's sleep and throw up their hillocks, and the "thriving pismire" issues from his vaulted galleries constructed in some decaying log or stump, while the angle worms emulate their six footed neighbors. During the mild days of March, ere the snow has melted away—

"The dandy Butterfly
All exquisitely drest,"

will visit our gardens. Such are various kinds of Vanessa, Grapta and Melitæa. The beautiful *Brephos infans* flies before the snow disappears.

"The Gnat, old back-bent fellow,
In frugal frieze coat drest"

will celebrate the coming of Spring, with his choral dance. Such is *Trichocera hyemalis*, which may be seen in multitudes towards twilight on mild evenings. Many Flies are now on the wing, such as Tachina and its allies, the four spotted Musquito, *Anopheles quadrimaculatus*, and the delicate species of Chironomus, whose males have such beautifully feathered antennæ, assemble in swarms. Now is the time for the collector to turn up stones and sticks by the river's side and in grassy damp pastures, for Ground Beetles (*Carabidæ*), and to frequent sunny paths for the gay Cicindela and the Bombylius Fly, or fish in brooks and pools for water Beetles and various larvæ of Neuroptera and Diptera; while many Flies and Beetles are attracted to freshly cut maples or birches running with sap; indeed many insects, rarely found elsewhere, assemble in quantities about the stumps of these trees, from which the sap oozes in March and April.—A. S. P.

*See an account of this curious insect in the Proceedings of the Essex Institute, vol. 4, p. 130. 1865.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History. *Jan.* 16, 1867.—Mr. W. Winwood Reade, referring to his own remarks at a previous meeting, stated that as the Cynocephalus must have been known to the Carthagenians in their own country, he was inclined to withdraw his opinion that this was the animal seen by Hanno in his celebrated voyage, and whose skins were hung up in the temple on the arrival home. He still did not believe it possible that it could have been the Chimpanzee, and considered the question still unsettled. He gave an interesting account of the manner in which the race of Fans on the West Coast of Africa entrap the Elephant, suggesting it as possible that the Elephant of the Equator differed from that of Southern Africa, in certain respects, being found only in small companies of from two or three to twenty, instead of large herds, while it is by no means as wary as the more Southern form. Having discovered the proximity of Elephants in the forest, the Fans build an enclosure in the neighborhood, by surrounding a somewhat open space of a few acres with a strong, though low fence, leaving a small opening on one side. Into this they entice the Elephants, by scattering food of which they are particularly fond, and by supplying them with food and besmearing the fence with some disagreeable compound, retain them within the enclosure, which the Elephants could otherwise without difficulty break down, where the natives kill them at their leisure. This tribe of Fans was pushing down from the interior toward the coast, and would soon supplant the Nepongwes, who were fast dying off, owing to the insalubrity of the climate, and who themselves, according to their traditions, formerly came from the "bush," or interior. The Fans were first made known to white men by the discovery of Mr. Wilson in 1852.

Essex Institute, *Salem. Jan.* 21, 1867.—Mr. F. W. Putnam called attention to a donation of several Snakes from Hong Kong, and remarked on the reptilian fauna of China, as compared with that of North America.

Mr. Putnam also called the attention of the Society to some observations recently published by Dr. B. Gilpin, of Halifax, N. S., on the habits of the Salmon, especially during the breeding season.

The members then discussed the origin of the *Black Wart* on the Plum Tree. The disease was regarded as being due to a constitutional decline of the tree, during which the bark loosens and cracks open, when a fungus (*Sphæria morbosa*) locates itself on the diseased part, giving it a swollen and black appearance. The grubs of the Plumb Weevil often live in the wart, but they have no agency in producing it.